auroral arch, with several small needles. Maximum brilliancy about midnight, when the display extended to about 35° altitude and 140° azimuth.

Fort Buford, Dak.: an aurora was observed 10.25 p. m., 28th, consisting of an irregular arch of a pale color extending to about altitude 15°, azimuth 75°. The arch rose gradually higher, and a second and brighter arch formed at 11.08 p. m. The arch first observed had now attained about altitude 25°, and extended to about 80° azimuth; the second arch was in about the same position that the first arch occupied when first observed. Both arches were now well-defined, also the dark segment. A few streamers of a reddish tinge appeared at the extreme points of the arches. The maximum brilliancy occurred between 12.52 a. m. and 1.20 a. m., March 1st. The arches united between 1 a. m. and 1.20 a. m., the lower merging into the upper, which then changed to a straw color. The dark segment continued well-defined. Between 1.40 a. m. and 2 a. m. the arch became diffused and appeared like a bank of smoke or fog slightly illuminated; the dark segment having disappeared. At 2.30 a. m. the aurora had disappeared.

Auroras were observed during the month as follows: 1st, Egg Harbor City, N. J. 2d, Provincetown, Mass. 3d, Poplar River, Mont., and Egg Harbor City, N. J. 5th, Saint Vincent, Minn. 7th, Angelica, N. Y. 15th and 16th, Angola, Ind. 17th, Poplar River, Mont. 19th, Leech Farm, Dak. 22d, Leech Farm, Dak.; Saint Vincent, Minn.; Poplar River, Mont. 26th, Leech Farm, Dak.; Saint Vincent, Minn.; Poplar River, Mont. 27th, Leech Farm, Dak. 28th, Kimball and Leech Farm, Dak.; Saint Vincent, Minn.; Alma, Calumet, and Sand Beach, Mich.

THUNDER-STORMS.

Thunder-storms were reported during the month, by states and territories, as follows: 1st and 2d, 1; 5th, 1; 7th, 2; 8th, 1; 9th, 2; 12th and 13th, 1; 15th, 7; 16th, 12; 17th, 9; 18th, 10; 19th, 3; 22d, 1; 26th, 2; 28th, 1. None were reported on the 3d, 4th, 6th, 10th, 11th, 14th, 20th, 21st, 23d to 25th, and 27th. They were reported in the greatest number of states and territories, twelve, on the 16th; in ten on the 18th; and in nine on the 17th. During this three-day period of their greatest frequency the thunder-storms were confined principally to the central and south-central states.

Thunder-storms were reported in the several states and territories, by days, as follows: Ala., 3; Dak., 1; Ga., 4; Ill., 1; Ind., 2; Iowa, 1; Kans., 2; Ky., 3; La., 2; Me., Md., and Mass., 1; Miss. and Mo., 4; Nev. and N. Mex., 1; N. C., 3; Ohio, 1; Tenn., 7; Tex., 4; Va., 2; Wash., 1; W. Va., 2; Wis., 1. In Ariz., Ark., Cal., Colo., Conn., D. C., Fla., Idaho, Ind. Ter., Mich., Minn., Mont., Nebr., N. H., N. J., N. Y., Oregon, Pa., R. I., S. C., Utah, and Wyo. no thunder-storms were reported. They were reported on the greatest number of days, 7, in Tennessee; in Georgia, Mississippi, and Missouri on 4; and in Alabama, Kentucky, and North Carolina on 3.

MISCELLANEOUS PHENOMENA.

FOREST AND PRAIRIE FIRES.

Prairie fires were reported as follows: Fort Reno, Ind. T., 2d to 7th; Fort Sill, Ind. T., 2d to 7th, 9th to 16th, 18th to 22d. Forest fires were noted at Red Bluff, Cal., 4th, 21st, 28th.

HALOS.

Solar halos were most frequently noted in Pennsylvania, where they occurred on fourteen days. In Dak., Ill., Mass., and Tenn. they were reported on thirteen days; in New York on eleven; and in Mich., Minn., N. J., and Ohio on ten days. None were reported in Ala., Del., D. C., Ind. Ter., Ky., N. Mex., N. C., R. I., and Utah. They were noted in the greatest number of states and territories, 17, on the 21st; in 12 on on the 7th; in 11 on the 13th and 24th; and in 10 on the 10th, 11th, 18th, and 20th. There were no days for which solar halos were not reported in one or more states or territories.

A display of parhelia, noted the 21st, at Spearfish, Lawrence Co., Dak., is described as follows in the "Queen City Mail," published at that place: "Parhelia, or mock suns, were observed in the morning. The display was composed of three distinct circles of rainbow-tinted light, the first encircling the sun and the others outside and crossing the first at its centre. Each ring or circle was studded with four mock suns on its rim, dividing the circle into four equal parts. The display was very brilliant and lasted over an hour."

Lunar halos were most frequently noted in California, where they were reported on twelve dates. In Missouri and Oregon they occurred on eleven dates; in Dakota and New York on ten; in Ohio and Texas on nine; and in La., Mass., Tenn., and Wash. on eight. None were reported in Conn., Del., N. Mex., R. I., Utah, and Vt. They were reported in the greatest number of states and territories, 23, on the 13th; in 18 on the 9th and 12th; in 17 on the 11th and 14th; and in 16 on the 7th. On the 27th and 28th no lunar halos were reported.

METEORS.

The distribution of meteors, by dates, was as follows: 1st, Villa City, Fla. 3d, Queensbury, N. Y. 7th, Lexington, Ky.; Barren Creek Springs and Fallston, Md.; Beverly, Camden, Clayton, Egg Harbor City, New Brunswick, and Somers Point, N. J.; Ardenia and Newburgh, N. Y. 14th, Ellicott City, Md.; Egg Harbor City, N. J. 15th, Limona, Fla. 17th, Villa City, Fla. 20th, Nashua, N. H. 24th, Eden Centre, N. Y.; Westerville, Ohio. 27th, East Portland, Oregon. 28th, Santa Maria, Cal.

The following are descriptions of the more notable meteoric displays reported; those relating to meteors observed between 5 and 6 p. m. of the 7th, at stations in Maryland, New Jersey, and southern New York, being especially noteworthy:

Fallston, Harford Co., Md.: a large meteor observed in the full light of the day at 5 p. m., 7th, passing along the northern horizon towards the west.—*Report of voluntary observer.*

Egg Harbor City, N. J.: a large and bright meteor passed in a horizontal direction from east to west at 5.10 p. m., 7th; it exploded and caused a rumbling like thunder, and left a bright trail which remained in sight about five seconds.—*Report of voluntary observer.*

Beverly, Burlington Co., N. J.: a large meteor was seen in the east-northeast, altitude 45°, at 5.20 p. m., 7th, apparently moving southward. At the instant it was observed the head appeared to separate from the tail and explode, bursting into small, fiery fragments which fell toward the ground. The display lasted ten or twelve seconds; no sound was heard.—*Report of voluntary observer.*

Camden, N. J.: a meteor was seen about 5.25 p. m., 7th, going in a northwesterly direction, leaving a long trail of light. The meteor appeared to gradually diminish in size, and finally burst into two parts and vanished.—*Atlantic Review, Feb. 9th.*

New Brunswick, N. J.: about 5.30 p. m., 7th, a meteor appeared in the southwestern sky and traveled leisurely in a westerly direction until it exploded with a tremendous report that was heard not only all over this city but for miles around. Its bursting was like that of a large rocket, and was accompanied by a magnificent display of many colored lights. The observer at Princeton says: The meteor was in the west, altitude 30°, and resembled a big ball of fire going at a rapid rate and accompanied by a loud rumbling noise. It threw off a myriad of bright sparks, similar to a huge sky-rocket. In its trail was a long mass of bluish red flame. A few seconds later it burst with a loud report and display of vari-colored sparks.—*Report of New Jersey State Weather Service.*

Somers Point, Atlantic Co., N. J.: a meteor was observed at 5.35 p. m., 7th, passing from the south in a northerly direc-

tion and rapidly nearing the earth. In a few moments it exploded, separating into three fragments, one going northward, one westward, and the third northwestward. A stream of fire and smoke was observed after the explosion.—*Atlantic Review.*

Newburgh, N. Y.: a large meteor fell on a farm in Orange county on the 7th. It was very brilliant, and in color yellow tinged with green. It broke into many small pieces, and the snow, covering about an acre, was found perforated, as with gravel stones.—*The (Nashville, Tenn.) Daily American, Feb. 12th.*

Ellicott City, Howard Co., Md.: a brilliant, luminous, cylindrical body passed over this place the night of the 15th, seemingly not more than several hundred feet above the earth, and, forming a curve, appeared to descend to the ground about a mile from the village. Its course was in a northwesterly direction, and during the several seconds it was visible the vicinity was lighted as by an electric light.—*The (Baltimore) Sun, Feb. 16th.*

Ljmona, Hillsborough Co., Fla.: a large meteor passed from the meridian toward the southeast at 10.30 p. m., 15th. A few minutes after, and near the point where this one disappeared, another, having the appearance of burning sulphur, with falling sparks of red, white, and green colors, was seen crossing the southern sky towards the west. Some seconds later two other meteors started, from the place of the last-mentioned, and moved southeasterly.—*Reported by Mrs. G. K. Mead.*

NOTE.—The meteor noted in January, 1889, REVIEW, for Rio Grande, N. J., was observed February 12, 1889.

MIRAGE.

Mirage were reported as follows: Woonsocket, Dak., 7th, 23d. Hampton, Iowa, 15th. Yuma, Ariz.: a mirage was observed in the southeast just before sunrise on the 5th; distant mountains below the horizon were seen with inverted images above. A mirage was also observed in the southeast on the 7th.—*Report of Signal Service observer.*

Colegrove, Los Angeles Co., Cal.: San Nicholas Island, situated about seventy-five miles southwest of this place, and ordinarily hidden from view, was visible the afternoons of the 10th, 11th, 27th, and 28th.—*Report of voluntary observer.*

SAND STORMS.

Dodge City, Kans.: a very severe sand storm prevailed during the day of the 4th. The wind attained a maximum velocity of fifty-eight miles per hour at 2.15 p. m., blowing down chimneys and out-houses.—*Report of Signal Service observer.* Yuma, Ariz.: a violent sand storm prevailed during the afternoon of the 14th; maximum velocity of wind forty-six miles per hour.—*Report of Signal Service observer.* Sand storms also occurred at Fort Bowie, Ariz., 13th, and Willcox, Ariz., 14th and 15th.

SUN SPOTS.

Haverford College Observatory, Pa. (observed by Mr. H. V. Gummere):

Date. February, 1889.	Number of new—		Disappeared by solar rotation.		Reappeared by solar rotation.		Total number visible.		Faculæ.		Remarks.
	Groups.	Spots.	Groups.	Spots.	Groups.	Spots.	Groups.	Spots.	Groups.	Spots.	
1, 10 a. m ...	1	6	0	0	0	0	1	6	1	8	Definition good; count of faculæ stopped by clouds.
7, 10 a. m ...	0	0	0	0	0	0	0	0	4	4	Definition good.
9, 11 a. m ...	0	0	0	0	0	0	0	0	15	59	Definition very good.
12, 10 a. m ...	0	0	0	0	0	0	0	0	4	13	Definition good.
13, 11 a. m ...	0	0	0	0	0	0	0	0	4	11	Definition good.
14, 11 a. m ...	0	0	0	0	0	0	0	0	3	8	Definition poor.
20, 11 a. m ...	0	0	0	0	0	0	0	0	5	16	Definition good.
21, 12 m	0	0	0	0	0	0	0	0	3	5	Definition poor.
25, 10 a. m ...	0	0	0	0	0	0	0	0	1	1	Definition poor.
26, 11 a. m ...	1	14	0	0	0	0	1	14	4	12	Definition good.

Mr. John W. James, Riley, McHenry Co., Ill.: the only ones seen were two small spots, half way from east edge to sun's meridian, on the 2d; these had vanished by the 5th; and a group of six small spots, two days west of meridian, on the 28th. Mr. H. D. Gowey, North Lewisburgh, Champaign Co., Ohio: sun-spots were observed on the 1st and 28th.

VERIFICATIONS.

Owing to an interruption of work, due to a change in the location of this office, the percentages of the official indications of the Signal Service for February, 1889, were not completed in time to be published in this issue of the REVIEW. They will be published in the next number.

Percentages of local verifications of weather and temperature signals as reported by directors of the various State Weather Services for February, 1889.

States.	Weather.	Temperature.	States.	Weather.	Temperature.
Illinois	83.2	80.1	New Jersey	76.6	92.7
Indiana	87.7	85.7	New York	78.0	80.0
Kansas	84.8	89.7	North Carolina	79.8	72.5
Louisiana (northern)	80.0	92.0	Ohio	89.0	85.0
Louisiana (southern)	74.0	83.0	South Carolina	81.0	83.5
Michigan	82.9	81.1	Tennessee	84.5	77.8
Minnesota	87.0	80.0	Texas	87.0	86.0
Nebraska	82.2	85.0			

STATE WEATHER SERVICES.

[*Temperature in degrees Fahrenheit; precipitation, including melted snow, in inches and hundredths.*]

The following extracts are republished from reports for February, 1889, of the directors of the various state weather services:

ALABAMA.

The month has been colder than usual in all portions of the state, and the average temperature was 2.9 below the normal. The coldest day was the 7th, and the warmest period was the 16th and 17th. The warm wave crossed the northern part of the state on the 16th and was felt in south Alabama on the 17th. The close of the month moderated sufficiently to cause the buds of fruit trees to open rapidly.

There was a deficiency of rain at a majority of the stations and the average precipitation was 0.5 below the normal. The fall of snow that occurred on the 21st was large for this climate, but on account of the shallow depth, 2 inches, it remained on the ground only a few hours.

The weather has been generally favorable for farming operations, and the farmers have made satisfactory progress in placing the seed in the ground.

Summary.

Temperature.—Monthly mean, 46.8; highest monthly mean, 50.6, at Tuscaloosa; lowest monthly mean, 39.8, at Valley Head; maximum, 80, at Montgomery, 17th; minimum, 7, at Valley Head, 7th; range for state, 78; greatest local monthly range, 62 at Motes; least local monthly range, 41 at Mobile.

Precipitation.—Average for the state, 4.29; greatest, 7.14, at Valley Head; least, 2.00, at Greensborough.

Wind.—Prevailing direction, northwest.—*P. H. Mell, Signal Corps, Auburn, director.*

ARKANSAS.

Summary.

Temperature.—Monthly mean, 48.1; highest monthly mean, 49.9, at Texarkana; lowest monthly mean, 36.7, at Lead Hill; maximum, 85, at Texarkana, 16th; minimum, 4, at Eureka Springs, 6th; range for state, 81; greatest local monthly range, 72, at Eureka Springs; least local monthly range, 38, at Dallas.

Precipitation.—Average for the state, 2.53; greatest, 5.80, at El Dorado; least, 1.02, at Heber.—*Prof. John C. Branner, Little Rock, director; W. U. Simons, Sergeant, Signal Corps, assistant.*

ILLINOIS.

Temperature.—Mean of the northern division, 20; of the central division, 26; of the southern division, 31; maximum for northern division, 64, at